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Numbers such as $\frac{1}{37}, \frac{1}{370}, \frac{1}{5371}$ shall be omitted, numbers such as $\frac{1}{73}, \frac{1}{307}, \frac{1}{5317}$ shall be admitted as terms of the series. (Compare AMERICAN MATHEMATICAL MONTHLY, Volume XXI, page 123.)

SOLUTIONS OF PROBLEMS.

ALGEBRA.

421. Proposed by C. N. SCHMALL, New York City.

Give a trigonometrical solution of the general quadratic equation.

SOLUTION BY PAUL CAPRON, United States Naval Academy.

Let the equation be

$$ax^2 + bx + c = 0 \qquad (a > 0).$$

Then the algebraic solution

$$x = \frac{b}{2a}\left(-1 \pm \sqrt{1 - \frac{4ac}{b^2}}\right)$$

may be evaluated:

(1) If $c > 0$, let

$$\frac{4ac}{b^2} = \sin^2\theta;$$

then

$$x = \frac{b}{2a}(-1 \pm \cos\theta) = -\frac{b}{a}\sin^2\frac{\theta}{2} \qquad \text{or} \qquad -\frac{b}{a}\cos^2\frac{\theta}{2}.$$

(2) If $c < 0$, let

$$-\frac{4ac}{b^2} = \tan^2\phi;$$

then

$$x = \frac{b}{2a}(-1 \pm \sec\phi) = \frac{b}{a}\sec\phi\sin^2\frac{\phi}{2} \qquad \text{or} \qquad -\frac{b}{a}\sec\phi\cos^2\frac{\phi}{2}.$$

If tables of the hyperbolic functions are at hand, the following is simpler than (2):

(3) If $c < 0$, let

$$-\frac{4ac}{b^2} = \sinh^2 y;$$

then

$$x = \frac{b}{2a}(1 - \pm\cosh y) = \frac{b}{2a}\sinh^2 y/2 \qquad \text{or} \qquad -\frac{b}{2a}\cosh^2 y/2.$$

If a table of haversines is available, the following is simpler than (1):

(4) If $c > 0$, let

$$\frac{4ac}{b^2} = \sin^2\theta;$$

then

$$x = -\frac{b}{a}\,\text{hav}\,\theta \qquad \text{or} \qquad -\frac{b}{a}\,\text{hav}\,(180^\circ - \theta).$$

Also solved by the PROPOSER.